OCCASIONAL PAPERS OF THE
FARLOW HERBARIUM OF CRYPTOGAMIC BOTANY

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# Further Observations on *Verrucaria serpuloides* M. Lamb, the Only Known Permanently Submerged Marine Lichen

I. Mackenzie Lamb

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No. 1. Sylvia A. Earle: *Hummbrella,* a New Red Alga of Uncertain Taxonomic Position from the Juan Fernandez Islands (June 1969).

No. 2. I. Mackenzie Lamb: *Stereocaulon arenarium* (Sav.) M. Lamb, a Hitherto Overlooked Boreal-Arctic Lichen (June 1972).

No. 3. Sylvia A. Earle and Joyce Redemsky Young: *Siphonoclathrus,* a New Genus of Chlorophyta (Siphonales: Codiaceae) from Panama (July 1972).

No. 4. I. Mackenzie Lamb, William A. Weber, H. Martin Jahns, Siegfried Huneck: *Calathaspis,* a New Genus of the Lichen Family Cladoniaceae (July 1972).

No. 5. I. Mackenzie Lamb: *Stereocaulon sterile* (Sav.) M. Lamb and *Stereocaulon groenlandicum* (Dahl) M. Lamb, Two More Hitherto Overlooked Lichen Species (March 1973).

No. 6. I. Mackenzie Lamb: Further Observations on *Verrucaria serpuloides* M. Lamb, the Only Known Permanently Submerged Marine Lichen (April 1973).

# FURTHER OBSERVATIONS ON *VERRUCARIA SERPULOIDES* M. LAMB, THE ONLY KNOWN PERMANENTLY SUBMERGED MARINE LICHEN

I. MACKENZIE LAMB
FARLOW HERBARIUM, HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS 02138

*Verrucaria serpuloides* is a pyrenocarp lichen occurring permanently submerged in the ocean on the coasts of the Antarctic Peninsula; it was first described from two localities, Port Lockroy and Hope Bay, on the west and east sides of the northern part of the Peninsula respectively (Lamb, 1948, p. 20, Fig. 3e, Pl. I, Fig. 2, Pl. II, Fig. 1, Pl. IV, Fig. 8). These collections, made by the author in 1944 and 1945, were from just below the water level at lowest spring tides, demonstrating the fact that it is a permanently submerged species. At that time, however, there was no means of determining whether it was confined to the uppermost infralittoral belt or whether it occurred also at greater depths.

In 1964-65 the author returned to the Antarctic Peninsula with equipment for self-contained underwater diving (SCUBA), and made a number of dives at various localities on the west side of the Antarctic Peninsula for the purpose of collecting benthic marine algae.[1] In one place in the Melchior Archipelago, a sheltered inlet beside the Argentine Naval Hydrographic station on Gamma Island (Isla Observatorio), *Verrucaria serpuloides* was found in abundance on stones and rocks at a depth of 4-10 meters below mean low tide level (Figs. 1, 2), forming irregular black patches up to 30 cm or more in diameter. Fresh material brought up and sectioned (Lamb no. 7886) showed the following features:

The thallus in the living state is entirely jet-black, with matt surface, continuous, without cracks. (After 3 days drying the edge of the thallus begins to turn brownish in a narrow peripheral zone, and in specimens dried for several months the whole thallus turns dark brown and becomes irregularly sharply cracked by post-mortem contraction into areolar portions 1-4 mm across. Herbarium specimens therefore have an appearance quite different from that of the living lichen.)

The average thickness of the thallus is 500 $\mu$; it is entirely pseudo-

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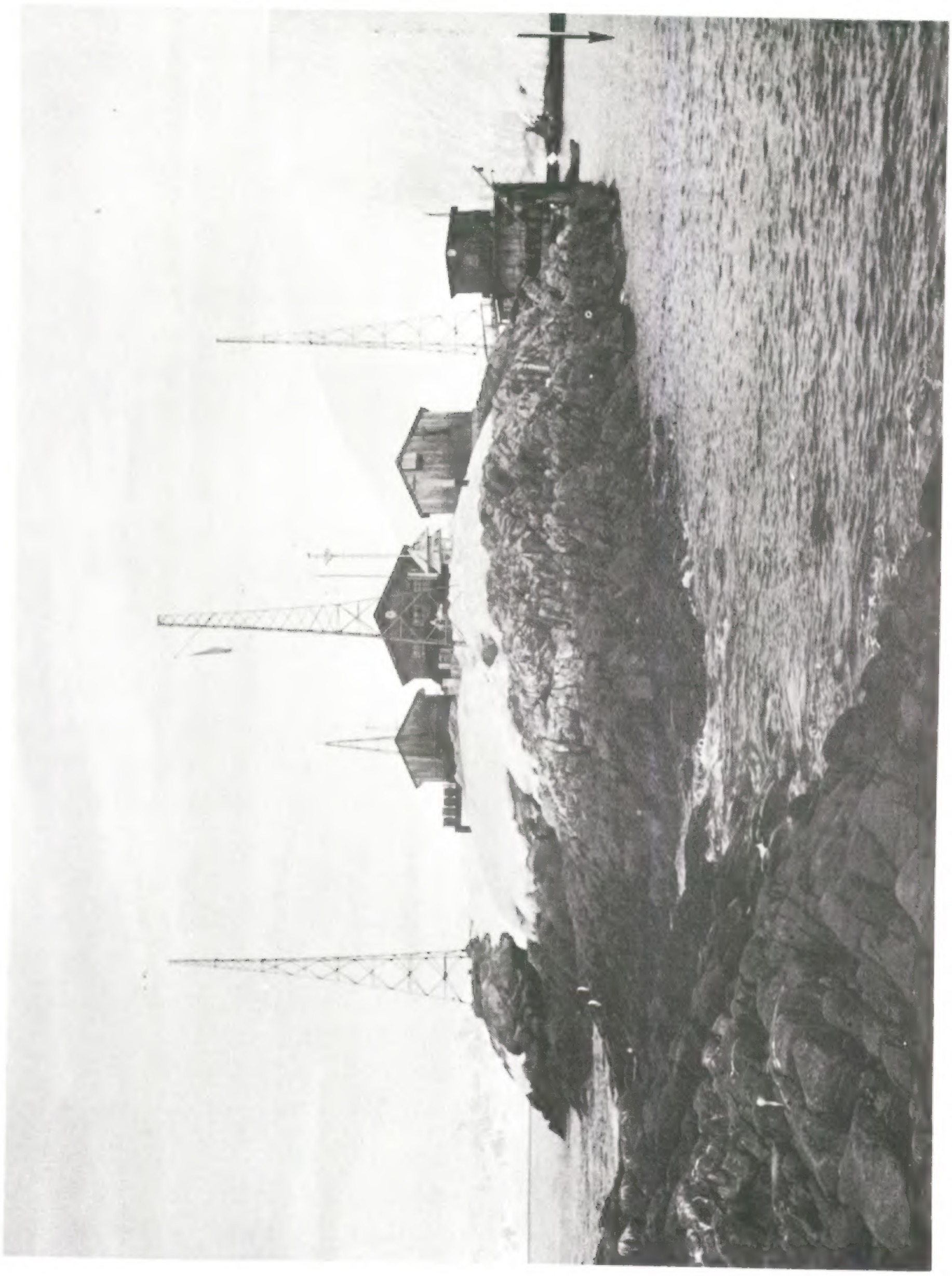

FIG. 1. The station inlet, Gamma Island, Melchior Archipelago, W. Antarctica. Arrow points to the location where *Verrucaria serpuloides* was collected 9 m below the water surface.

FIG. 2. *Verrucaria serpuloides* on rock at bottom of station inlet, Gamma Island, at depth of 9 m. It forms a black patch along the base of the rock where it rests on the sandy bottom. The light patches on the same rock are an encrusting calcareous red alga (*Lithothamnium* or *Lithophyllum*).

parenchymatous in structure (Fig. 3), with the symbiotic algae in vertical rows embedded in the colorless fungal tissue, the cells of which are isodiametric or slightly vertically elongated, 2-3 $\mu$ in diameter, angulose, thin-walled, often containing a refractive globule. The lowermost 50-90 $\mu$ of the thallus is free of algae, consisting of a dense, colorless pseudoparenchyma, the basal 10-15 $\mu$ of which, in direct contact with the rock, is darkened (brown-blackish). The algal cells are distributed through almost the entire depth of the thallus, in vertical rows, often showing distinct connection in short cell-chains; they are bright green, isodiametric or slightly elongated, 4-7 $\mu$ in diameter or up to 9 $\times$ 6 $\mu$, with thin walls; no pyrenoid is apparent. Attempts to bring the alga into pure culture were unfortunately unsuccessful, so that its taxonomic identity cannot at present be ascertained.[2] The upper surface of the thallus is

[2] The algal symbiont of another marine *Verrucaria* species, *V. erichsenii* Zschacke, has been cultured and determined by Dr. V. Ahmadjian as *Pseudopleurococcus* Snow (Chlorophycophyta, Trentepohliaceae, close to *Gongrosira* Chodat), from a specimen collected by the author at Nahant, Massachusetts (Ahmadjian, personal communication, 1967).

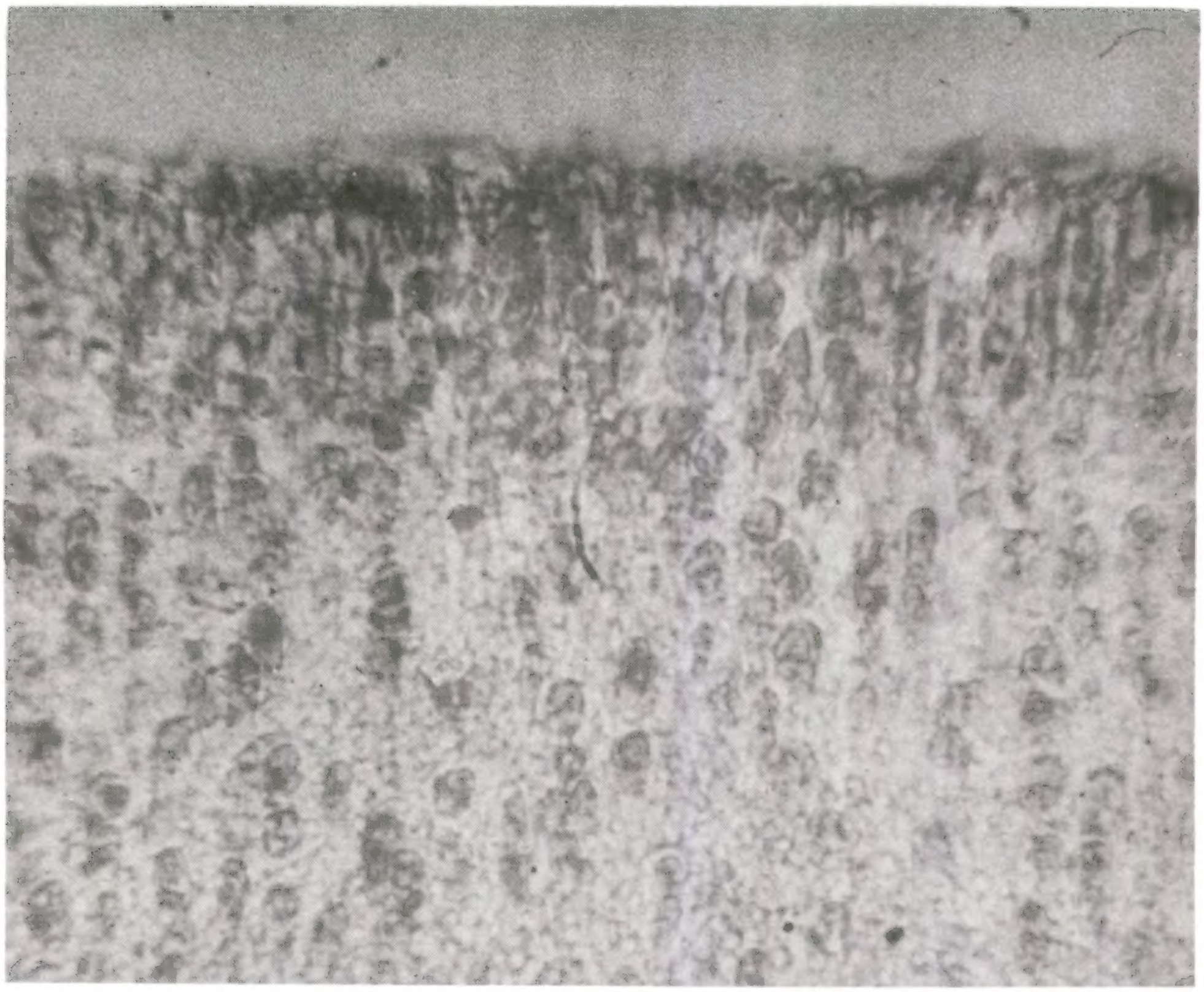

FIG. 3. *Verrucaria serpuloides* (Lamb no. 7886). Section of upper part of thallus in living material, showing symbiotic algae embedded in pseudoparenchymatous fungal tissue.

covered by a rudimentary, pigmented cortex consisting of a single layer of isodiametric cells; its color in thin sections is pale smoky brown. The cortical cells are thin-walled, 2-3 $\mu$ in diameter.

Perithecia are numerous, evenly scattered; the emergent part rising above thallus-level is 0.2-0.4 mm in diameter, tumid-discoid, with the fine ostiolar pore in a concave depression. Mature perithecia (Fig. 4) are 350-450 $\mu$ in diameter, with a well developed dark apical shield (involucrellum) and an entire, pale brownish excipular wall. The perithecia are filled with a colorless mucilage, with numerous asci but no paraphyses. The walls of the asci rapidly become deliquescent, and cannot be well seen in living unstained material, but their spore-contents remain for some time visible in distinct, $\pm$ biseriate groups of 8. The spores are colorless, broadly ellipsoid, 15.0-17.5 $\times$ 8.0-9.5 $\mu$, thin-walled, usually containing one to several refractive globules. Released by deliquescence of the ascus-wall, they lie randomly distributed in the mucilage in the

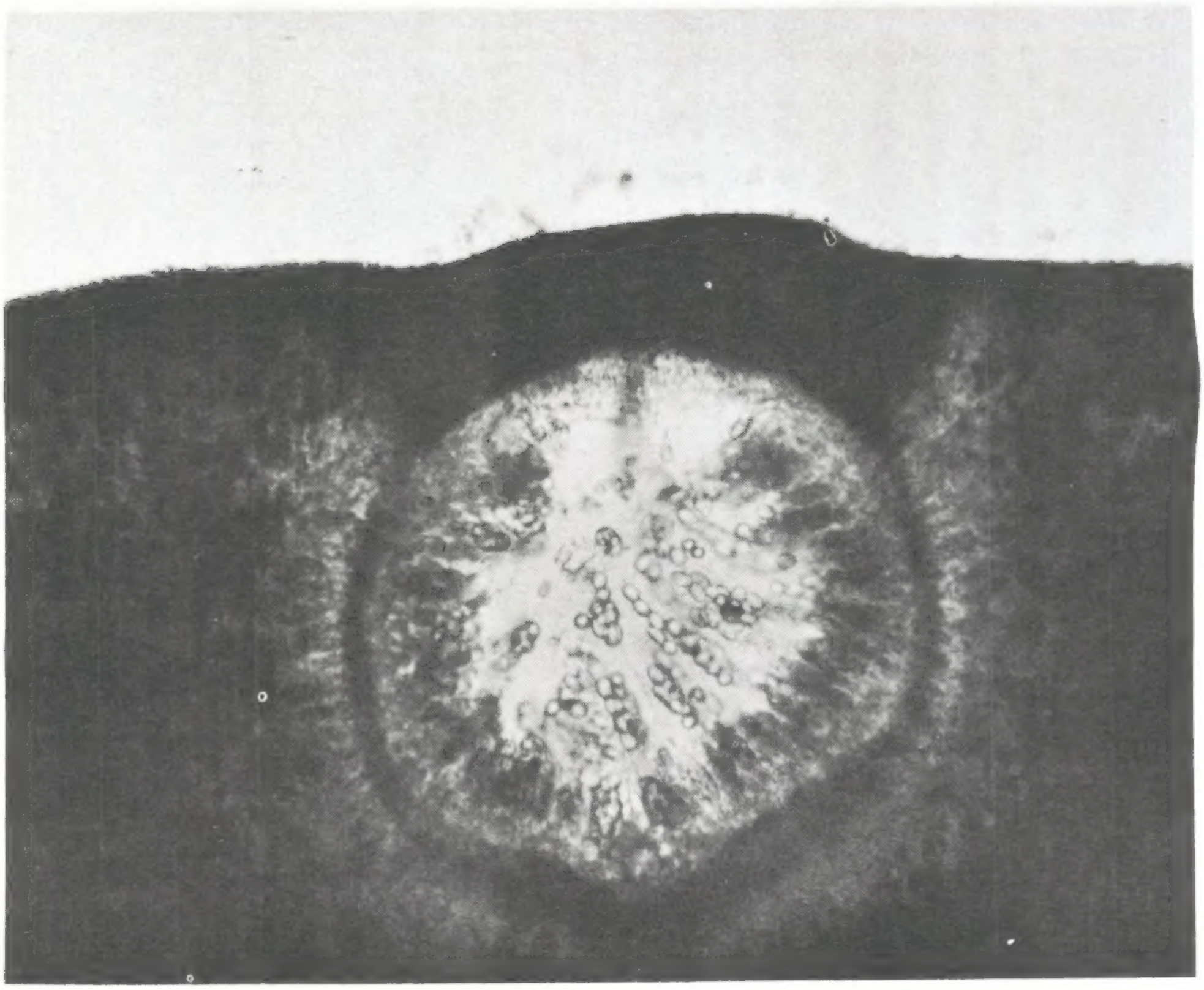

FIG. 4. *Verrucaria serpuloides* (Lamb no. 7886). Section of a perithecium in living material.

upper part of the perithecial cavity, and are gradually extruded, surrounded by mucilage, through the narrow apical ostiolar opening.

Immersed flask-shaped pycnidia, with bacilliform conidia, were observed in the original material (Lamb, *loc. cit.*).

Dried material of the specimen examined and here described is preserved in the Farlow Herbarium of Harvard University.

The photographs for Figs. 1 and 2 were made and supplied by Dr. Martin H. Zimmermann, who was in charge of underwater photography on the 1964-65 expedition, and whose effective collaboration is gratefully acknowledged. Thanks are also due to Miss Elke Mackenzie for indispensable technical and bibliographic aid in the preparation of this paper.

## Reference

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